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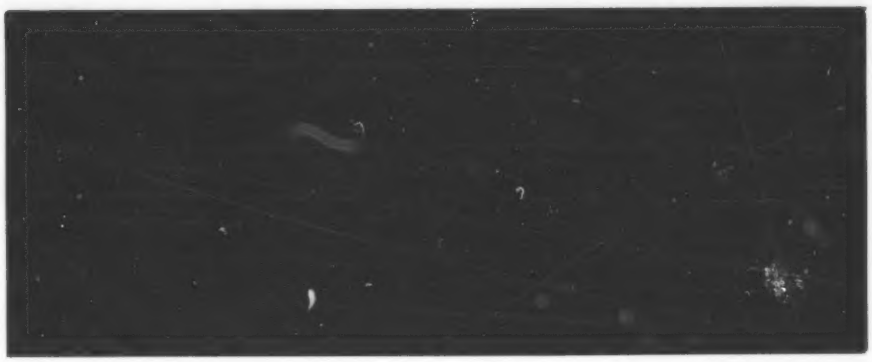

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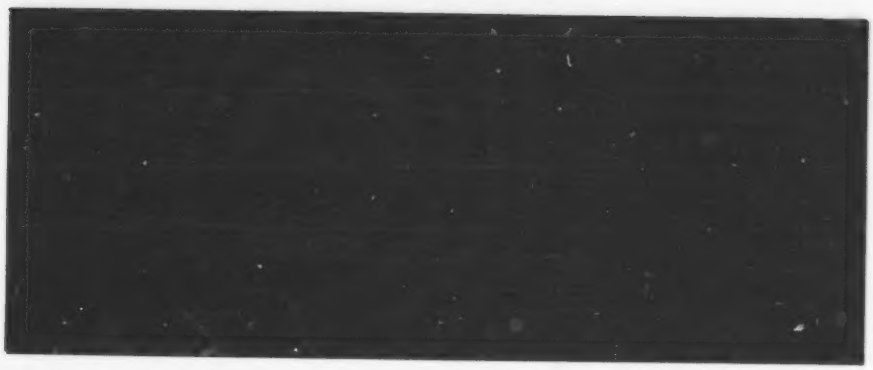

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EFFECTS OF STEM CRUSHING (CRIMPING) AND STEM SIZE ON THE RATE OF DRYING OF KOCHIA FORAGE FOR HAY

by

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SRC Publication No. R-814-1-E-88

February, 1988

91-01752/

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ACKNOWLEDGEMENTS

This study was funded by the Canada-Saskatchewan ERDA Agreement, contract #2.2-10.

The statistics were conducted by J. Kernan and A. Mair.

ABSTRACT

The rate of air drying of young kochia forage could be greatly increased by crushing (crimping) of the forage prior to air drying. This result is in agreement with the comments of farmers obtained in a recent survey.

Stem size affected rate of drying, i.e., the larger the stems, the slower the rate of drying.

INTRODUCTION

Farmers in western Canada who have used kochia (Kochia scoparia L. Schrad.) as an annual hay crop have reported that it is very difficult to dry compared to conventional grass and legume hays (Norris, 1987, Wotherspoon, 1987). These farmers had observed that crimping (crushing stems during swathing and placing in windrows for drying) speeded up the drying process. A survey of over 50 farmers with experience harvesting kochia also indicated that slow drying of kochia was a problem (Hanson, 1987).

Kochia is a halophyte (Redmann and Fedec, 1987) and accumulates larger amounts of salts in the vegetative tissues than do conventional forages (Bell et al., 1954). The salts tend to be of higher concentration in the leaves than the stems at later stages of digestibility, but about the same in young (prebud) plants (Sherrod, 1971, Kernan et al., 1986, Green et al. 1986). If high concentrations of salts in the leaves and stems caused a high osmotic potential, this might reduce the rate of drying of leaves and stems.

Stage of maturity could also have an effect on rate of drying. Feed value of younger kochia forage is higher (crude protein content, organic matter digestibility) than older maturity kochia (Sherrod, 1971, Coxworth et al., 1987) but salt concentration is higher in younger kochia and this might increase the difficulty in drying kochia in the swath prior to baling. One farmer was of the opinion that older kochia (flowering) was easier to dry for hay than younger kochia (bud or prebud) (Brownlee, 1986). However older kochia (e.g. flowering or early seed formation stages) has woody, stiff main stems which tended to be rejected by cattle in silage feeding trials (Finley and Sherrod, 1971).

This study was designed to test the effect of crushing stems on the rate of drying of young (prebud) kochia, and the effect of stem size (at prebud stage) on rate of drying, with or without crushing stems.

MATERIALS AND METHODS

Young wild kochia plants were collected from disturbed soil sites near the corner of Preston Avenue and 108th St. in Saskatoon on June 17, 1987. Plants were at the pre-bud stage of maturity. Plants were collected at several locations within the site to give plants of different stem sizes. Plants were cut very close to the ground (2-4 cm) so as to collect all stems. (Farmers would likely tend to cut higher above the ground which would also avoid the thicker, woodier base of the plants).

Plants were taken immediately to the laboratory. There they were sorted to give plants of large stems (9-19 mm diameter near the base of the plants) and small stems (4-7 cm diameter). Each group of plants was further separated into 6 similar subsamples. All the samples were weighed to record the fresh weight. Half of the subsamples (3 each of large and small stems) were placed in thin layers on a hard bench top and crushed by rolling a heavy wood roller (~ 7 cm diameter) over the plants from bottom to top several times, until the stems were visibly crushed and split open, and liquid started to be expelled from the leaves. All samples were placed separately in muslin bags in thin layers, and dried on wire racks in a drying cabinet with a fan operating to cause an air flow around and through the muslin bags. Air temperature was maintained at or slightly above ambient temperature so as to dry at 25-30°C.

Plants in the bags were removed from the drier at periodic intervals, removed from the bags, weighed, and returned to the bags for further drying. Each time the samples were removed from the drying cabinet for weighing they were inspected by hand for dryness (brittleness) of leaves and stems. After 4 2/3 days (112 hours) drying at 25-30°C, the individual samples were placed on metal trays and dried at 60°C in an oven for 24 hours, to record oven dry weight.

The results were analyzed statistically by a two way analysis of variance.

RESULTS AND DISCUSSION

The percentage moisture in the samples was calculated according the equation: $\% \text{ moisture} = \frac{\text{Sample weight - sample oven dry weight}}{\text{Sample weight}} \times 100$

Results are shown in table 1 and figure 1.

Table 1. Effect of plant crushing and stem size on rate of drying of prebud kochia forage.

Kochia	Stem Diameter (mm)	Plant Height (cm)	% Moisture after hours Drying 0	21	45	112
Large Stems						
Uncrushed	12.7	87	79	68	55	34
Crushed	13.7	86	80	53	29	10
Small Stems						
Uncrushed	4.7	70	80	69	55	28
Crushed	6.0	73	80	51	25	5
Significance of crushing effect	NA	NA	NS	**	**	**
Significance of stem size	**	**	NS	NS	NS	*
Significance of crushing x stem size interaction	NA	NA	NS	NS	NS	NS

NA - not applicable
NS - not significant
* - significant at the 5% level
** - significant at the 1% level

Figure 1 illustrates the effects of crushing and of stem size, and allowed estimation of the time required for the hay to dry to 15% moisture, a moisture content usually considered safe to bale and store hay. Times required to dry to 15% moisture are shown in table 2.

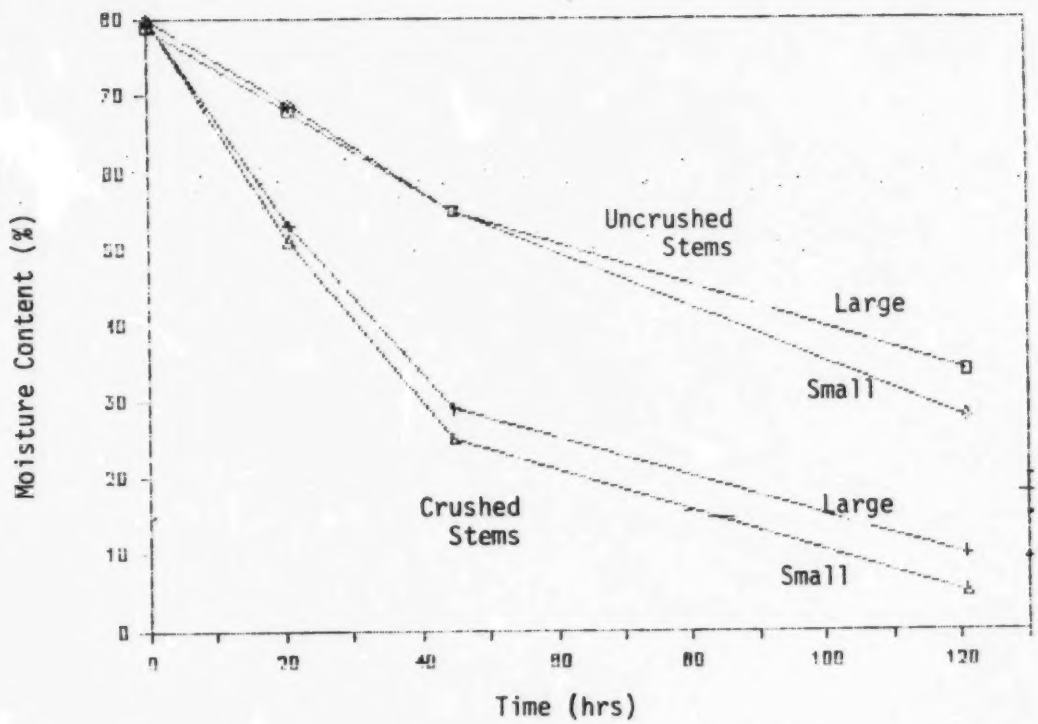

Figure 1. Effects of crushing and stem size on the rate of drying of young kochia hay.

Table 2. Times required to dry kochia forage to 15% moisture (hay dry basis).

Sample description	Drying Time (Hours)
Small stems, crushed	78
Small stems, uncrushed	144[1]
Large stems, crushed	92
Large stems, uncrushed	189[1]

[1] Extrapolated from trends established up to 112 hours.

Crushing small stemmed plants enabled them to dry more quickly than uncrushed plants. The same benefit of crushing was observed for large stemmed plants. Small stemmed plants dried more quickly than large stemmed plants. Crushing tended to reduce the effect of stem size on rate of drying.

FURTHER STUDIES INDICATED

1. These results should be field tested with a mower/swather equipped with a good crimper.
2. The effect of stage of maturity on rate of drying kochia forage should be evaluated.
3. Kochia rate of drying should be compared with conventional grass and legume hays.
4. The effect of kochia plant populations on forage yields, stem size, feed value (including animal rejection of large stems) and on kochia rate of field drying to make hay, should be evaluated.

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